PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P6334PC	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/SE2004/000781	International filing date *(day/month/year)* 21/05/2004	Priority date *(day/month/year)* 23/05/2003
International Patent Classification (IPC) or national classification and IPC G01T1/16, A61N5/10		
Applicant Nilsson, Görgen		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *(sent to the applicant and to the International Bureau)* a total of 4 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s))
      _____, containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:
   - ☒ Box No. I Basis of the report
   - ☐ Box No. II Priority
   - ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - ☐ Box No. IV Lack of unity of invention
   - ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - ☐ Box No. VI Certain documents cited
   - ☐ Box No. VII Certain defects in the international application
   - ☐ Box No. VIII Certain observations on the international application

Date of submission of the demand	Date of completion of this report
05-11-2004	23-08-2005
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. +46 8 667 72 88	Authorized officer Nabil Sebaa /LR Telephone No. +46 8 782 25 00

Form PCT/IPEA/409 (cover sheet) (April 2005)

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/SE2004/000781

Box No. I Basis of the report

1. With regard to the **language**, this report is based on:

☐ the international application in the language in which it was filed

☐ a translation of the international application into _____ ,
which is the language of a translation furnished for the purposes of:

☐ international search (Rules 12.3(a) and 23.1(b))

☐ publication of the international application (Rule 12.4(a))

☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

☐ the international application as originally filed/furnished

☒ the description:

pages 1-21 as originally filed/furnished

pages* _____ received by this Authority on _____

pages* _____ received by this Authority on _____

☒ the claims:

pages _____ as originally filed/furnished

pages* _____ as amended (together with any statement) under Article 19

pages* 17-20 received by this Authority on 08/06/2005

pages* _____ received by this Authority on _____

☒ the drawings:

pages 1-4 as originally filed/furnished

pages* _____ received by this Authority on _____

pages* _____ received by this Authority on _____

☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages _____

☐ the claims, Nos. _____

☐ the drawings, sheets/figs _____

☐ the sequence listing *(specify)*: _____

☐ any table(s) related to the sequence listing *(specify)*: _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

☐ the description, pages _____

☐ the claims, Nos. _____

☐ the drawings, sheets/figs _____

☐ the sequence listing *(specify)*: _____

☐ any table(s) related to the sequence listing *(specify)*: _____

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

Box No. V **Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-18	YES
	Claims		NO
Inventive step (IS)	Claims	1-18	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-18	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

Based on the new claims 1-18 as amended under Article 19 PCT and filed on 15.11.2004, this Authority considers that the international application does comply with the requirements of unity of invention.

The invention relates to methods, a detector configuration, and a detector for verifying that a patient specific cancer treatment using radiation therapy is delivered as planned.

The object of the invention is to provide an efficient pre-treatment measurement method that accurately verifies the dose distribution from a complete treatment fraction to be delivered to a patient.

Documents cited in the International Search Report:
D1: US 5511107 A
D2: Agazaryan N. et al: "Three-dimentional verification for dynamic multileaf collimated IMRT"
D3: JURSINIC, P A et al: "A 2-D diode array and analysis software for verification of intensity modulated radiation therapy"
D4: BJÖRK, P et al: "Comparative dosimetry of diode and diamond detectors in electronic beams for intraoperative radiation therapy"
D5: CHUANG, C et al: "Investigation of the use of MOSFET for clinical IMRT dosimetric verification"
D6: SHI, J et al: "Important issues regarding diode performance in radiation therapy application"
D7: SOARES, C G et al: "Dosimetry of BETA-RAY ophthalmic applicators: comparison of different measurement methods"

.../...

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: Box V

Document D1, which is considered to represent the most relevant state of the art, discloses a system with a film detector for producing images representing radiation dose distributions in order to verify the radiation dose applied to a target area. In one embodiment, the system consists of a phantom with film detectors, wherein the film detectors are placed in three orthogonal planes for measuring the radiation dose applied to the target area in three dimensions (see D1 columns 1-2 and Figure 2).

The invention according to new claims 1-18 filed with the letter of 08/06/2005 differs from D1 in that measurements are divided in time-intervals, wherein each time interval has a maximum length of approximately 100 msec, which fulfils the requirements on high detection efficiency per unit volume, thus reducing the noise to a minimum.

The subject-matter of claims 1-18 is therefore novel (Article 33(2) PCT).

Consequently, the invention according to claims 1-18 is new, involves an inventive step and is industrially applicable.

Documents D2-D7 represent the general state of the art, and the invention claimed in claims 1-18 is not disclosed by these documents.

PCT / SE 2004 / 000781
10/551184 8 -06- 2005

SECOND SET OF AMENDED CLAIMS

1. Method of measuring dose distribution in a phantom for radiation therapy treatment verification, wherein at least two detector planes are arranged in said phantom in a non-parallel manner, each plane being provided with a plurality of diode detectors, wherein said phantom is irradiated using a patient specific treatment, comprising the steps of

obtaining information regarding the dose distribution inside said phantom by performing measurements using said detectors;

dividing the measurements in time-intervals, each time-interval having maximum length of approximately 100 msec; and

using said information in the treatment verification.

2. Method according to claim 1, wherein the information obtained by means of said measurements is used for IMRT verification.

3. Method according to claim 1 or 2, wherein said irradiation of the phantom comprises delivering dose pulses, further comprising the step of synchronizing the measurements with said delivered doses.

4. Method according to claim 1, 2, or 3, further comprising the steps of: synchronizing the measurements with a respiratory cycle of the patient for which the patent specific treatment is intended; and determining the dose delivered in the various phases of the respiratory cycle.

5. Method according to any one of claims 1-4, further comprising the step of storing the data for each specific time-interval for measurements in said phantom.

6. Method according to any one of preceding claims, further comprising the step of calculating correction factors for each time-interval using said obtained information regarding the dose distribution inside said phantom.

7. Method according to claim 6, wherein the correction factors are calculated according to

Corrn, f, seg-n, p, t(i), t(i+1) = Cdir*Cdepth*Cpos

where

Corrn, f, seg-n, p, t(i), t(i+1) The correction factor to be used with detector element n, in the sub field f in the phantom, correcting the measured dose integrated from time t(i) until t(i+1) to achieve the dose in the point of location of detector n

Cdir Factor correcting for any directional dependence in detector n

Cdepth Factor correcting for any depth (energy and/or dose rate) in detector n

Cpos Factor correcting for any position (in primary beam, outside primary beam, edge of primary beam, etc.) dependency in detector n.

8. Method according to claim 6, wherein the correction factors are calculated according to
Corrn, f, seg-n, p, t(i), t(i+1) = Cdir + Cdepth + Cpos

where

Corrn, f, seg-n, p, t(i), t(i+1) The correction factor to be used with detector element n, in the sub field f in the phantom, correcting the measured dose integrated from time t(i) until t(i+1) to achieve the dose in the point of location of detector n

Cdir Factor correcting for any directional dependence in detector n

Cdepth Factor correcting for any depth (energy and/or dose rate) in detector n

Cpos Factor correcting for any position (in primary beam, outside primary beam, edge of primary beam, etc.) dependency in detector n.

PCT / SE 2004 / 0 0 0 7 8 1
0 8 -06- 2005

9. Method according to any one of preceding claims, wherein the detector planes are arranged such that for each gantry angle projection, either of said non-parallel planes intersects with all parts of the radiation beam or sub-beams.

10. Method according to any one of the preceding claims , wherein each detector plane is provided with detectors having a thickness in a range less than the range of the electrons of the maximum energy in the range where the dependency is significant.

11. Method of measuring dose distribution in a phantom for radiation therapy treatment verification, wherein detector planes are arranged in said phantom, each plane being provided with a plurality of diode detectors, wherein said phantom is irradiated using a patient specific treatment, comprising the steps of

obtaining information regarding the dose distribution inside said phantom by performing measurements using said detectors;

dividing the measurements in time-intervals, each time-interval having maximum length of approximately 100 msec;

synchronizing the measurements with a respiratory cycle of the patient for which the patent specific treatment is intended;

determining the dose delivered in the various phases of the respiratory cycle; and

using said information in the treatment verification.

12. Method according to claim 11, wherein at least two detector planes are arranged in said phantom in a non-parallel manner.

13. Method according to claim 11 or 12 further comprising any one of the steps according to any one of the claims 2, 3, or 5-10.

14. Use of a detector configuration arranged in a phantom suitable for radiation therapy in a method according to any one of claims 1-12, said configuration comprising at least two detector planes provided with a plurality of diode detectors for measuring irradiation in said phantom, said irradiation being delivered using a patient specific treatment, wherein said planes being arranged in a non-parallel manner, wherein said detectors has a thickness in a range less than the range of

the electrons of the maximum energy in the range where the dependency is significant.

15. Detector configuration according to claim 14, wherein said non-parallel planes are arranged such that, for each gantry angel projection, either of said planes intersects with all parts of the radiation beam or sub-beams.

16. Use of a diode detector arranged with a thickness in a range less than the range of the electrons of the maximum energy in the range where the dependency is significant in a method according to any one of claims 1-12.

17. Diode detector according to claim 16, wherein said detector is used in water phantom dosimetry or in vivo dosimetry during Brachy therapy in Radio therapy.

18. Computer readable medium comprising instructions for bringing a computer to perform the steps of the method according to any one of the claims 1 to 13.